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EARTH SCIENCES

No. 7

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CONTENTS

OCEANOGRAPHY

CONTENTS (Continued) Page

TERRESTRIAL GEOPHYSICS

CONTENTS (Continued) Page

OCEANOGRAPHY

MAGNETIC INDUCTION FIELD OF SEA WIND WAVES

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 20, No 2, 1980 pp 305-310

[Article by V. N. Savchenko and V. P. Smagin, Far Eastern State University, "Magnetic Induction Fields of Sea Wind Waves in the Coastal and Shelf Zones"]

[Abstract] The authors computed the magnetic induction fields of sea wind eddy waves with a length from 5 to 200 m in coastal and shelf zones, taking into account the structure of the geomagnetic field and the distribution of the conductivity of sea water in northern, temperate and equatorial regions of the world ocean. The following subjects are discussed as background: conductivity of seas, hydrodynamic model of a wave and equations and computation formulas for the magnetic induction field. The results of the computations are given in Table 1, which gives the magnetic induction fields in the coastal zone, and Table 2, which gives the magnetic induction fields in the shelf zone. Table 2, for example, gives the computed values of components of the magnetic induction field in the shelf zone for a sea depth $H = 200$ m and $\gamma = 0.5$. The values are rather close for northern and equatorial seas (in northern seas the geomagnetic field has a considerable strength and conductivity is low; in equatorial seas the geomagnetic field is about twice less, but conductivity is almost twice as great). In all seas there is an insignificant difference in the vertical and along-crest components, but only at the sea surface; with depth the difference becomes significant. In all seas for 20 m there are almost no differences; for 40 and 80 m waves in the shelf zone they are less (at the maximum) by a factor of 1.2. In the shelf zone it is convenient to trace the behavior of the magnetic induction field with depth: the longer the wave, the slower is the decrease in its field. The along-crest component decreases far more rapidly. This makes it possible to conclude that at the bottom in the shelf zone wind wave fields are virtually absent. Tables 2; references 15: 11 Russian, 4 Western.
[303-5303]

NUMERICAL MODELING OF NEAR-WATER ATMOSPHERIC LAYER ABOVE DEVELOPED WAVES

Moscow OKEANOLOGIYA in Russian Vol 20, No 2, 1980 pp 211-217

[Article by V. K. Makin, Leningrad Division, Institute of Oceanology, "Numerical Modeling of Structure of Near-Water Atmospheric Layer in Presence of Well-Developed Waves"]

[Abstract] This article discusses the results of modeling of the structure of the near-water layer over a complex wave profile, constituting a superposing of simple harmonic waves traveling along the water surface. Each moment in time has a definite wave surface profile, aperiodic in time. The wave profile can be stipulated in such a way that its frequency spectrum will correspond to the spectrum of waves with completely developed waves. The author demonstrates that at each moment in time the discrete frequency spectrum of the wave-covered surface is described by a Pierson-Moskovits spectrum corresponding to this case of completely developed waves. The computation results are presented for typical sea conditions. They agree qualitatively with the physical concepts concerning the process of interaction between the wind field and waves. Figures 4; references 11: 6 Russian, 5 Western.
[299-5303]

SPECTRAL CHARACTERISTICS OF SLOPES OF WAVE-COVERED SEA SURFACE

Moscow OKEANOLOGIYA in Russian Vol 20, No 2, 1980 pp 218-222

[Article by I. P. Trubkin, State Oceanographic Institute, "Spectral Characteristics of Slopes of the Wave-Covered Sea Surface and Their Relationship to the Two-Dimensional Spectrum of Wind Waves"]

[Abstract] A study was made of the spectral characteristics of slopes of the wave-covered sea surface and their relationship to the two-dimensional frequency-directed spectrum of wind waves within the framework of the linear theory of potential waves with a small amplitude. It is assumed that the random field of wind waves within the limits of a definite time-and-space interval is stationary and uniform. Estimates of the spectral characteristics were obtained using data from field measurements. Measurements were made in the Caspian Sea from a piling platform using a wire wave recorder-slope meter. Slopes were determined from the difference in rises of the wave-covered surface at two points in space, the distance between which was 0.5 m. The sea depth at the site of sensor placement was 22 m. Wind speed at a height of 20 m above the sea was 7 $m \cdot sec^{-1}$. Mean wave height was 0.73 m and mean wave period was 3.67 sec. Each series lasted 5 minutes. The spectral characteristics were computed using a FFT algorithm. Among the findings were the following. The slope components represent, in

comparison with rises of the wave-covered surface, more high-frequency random processes having a complex polymodal spectral structure. The values of the quadrature part of the cross spectrum and the slope phase shift in the region of frequencies of the spectral maximum of waves differ from their theoretical zero level. A method is proposed for determining the parameters of the approximating expression for the angular distribution function for wave energy on the basis of data from slope measurements. Figures 2; 4 Russian, 2 Western.
[299-5303]

LIDAR METHODS FOR INVESTIGATING LONG WAVES ON SEA SURFACE

Moscow TEORIYA I OPERATIVNYY PROGNOZ TSUNAMI in Russian 1980 pp 154-158

[Article by B. V. Levin, B. M. Lysenko and V. Ye. Rokotyan, Sakhalin Multidiscipline Scientific Research Institute Far Eastern Scientific Center and Central Aerological Observatory, "Lidar Methods for Investigating Long Waves on the Sea Surface"]

[Abstract] The authors have analyzed the possibilities of using lidars for investigating long-period fluctuations of sea surface level (tides, seiche oscillations, tsunami waves). In order to have adequate range the lidar must be placed up to 100-500 m above the surface and the glancing angles of the rays must be small. The 500-m upper limit is set by meteorological factors. Lidar radiation is considerably attenuated when it propagates in clouds and its effective range is substantially reduced. The lower cloud boundary must be above the lidar. Fog creates additional difficulties. However, even in the Far East less than 10-15% of the time is unsuitable for lidar observations when the lidar is at a height less than 500 m. For example, if it is assumed that the lidar is at a height H = 100-500 m, the glancing angles are small ($a = 1-3°$), and the aperture angle is small ($\beta = 20°$), in such a case the irradiated area of the sea surface has the form of a long narrow oval. Its length will be L and the transverse dimension will be of the order of the diameter D of the light beam traveling the distance S to the beginning of the irradiated area. Table 1 gives the a, D and S values for different H and a. The length L of the irradiated spot is less than the characteristic wavelengths of tsunamis for almost all H and a values. The tsunami effect is therefore manifested in a change in the general surface slope, that is, in a change in signal duration on the oscillogram. The characteristic time for this change is of the order of the tsunami wave period, some tens of minutes, which is far greater than the periods of wind waves. The changes associated with tsunamis are superposed as a quasistationary background on the highly variable oscillations associated with wind waves. This makes it possible to discriminate these two types of waves. The change in the duration δ of the oscillogram, associated with the passage of a tsunami wave, must be adequate for its reliable registry. This means that δ must not be much less than the total duration of the oscillogram Δ.

The δ value is dependent on the height of the wave crest above the mean surface. Table 2 gives the maximum δ and mean Δ values for different wave heights h when the lidar is at H = 300 m. Thus, the factors exerting an influence on the possibility of registry are: energy of the emitted pulse, atmospheric transfer function, diameter of the receiving antenna, sensitivity of the photodetector and the value of the coefficient of light reflection from the sea surface. Tables 3; references 5: 4 Russian, 1 Western.
[290-5303]

STRUCTURE OF MIXED LAYER IN STRATIFIED FLUID

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 16, No 3, 1980 pp 284-293

[Article by V. A. Popov and Yu. D. Chashechkin, All-Union Scientific Research Institute of Physicotechnical and Radiotechnical Measurements, "Structure of the Mixed Layer in a Stratified Fluid"]

[Abstract] Optical and contact methods were used in investigating the structure of the mixed layer in a stably stratified fluid arising under the influence of a constant velocity shear at the free surface. It was found that the spatial structure of currents excited in such a fluid changes considerably with an increase in velocity. With small shear stresses, when $Ri_0 > 0.3$, a stationary two-layer circulation current is formed with an identical direction of rotation of the fluid and the sloping discontinuity between the layers. The density gradient is maximum at the discontinuities. The lower boundary of the current is horizontal; the entrainment rate is virtually equal to zero. In the case of large shear stresses $Ri_0 < 0.1$ there is formation of a turbulent mixed layer whose thickness is not a monotonic function of dimensionless time τ. In the initial stage $h \sim \tau$, which coincides with the dependence of layer thickness on time in the model of formation of turbulence by a mean flow with a velocity shear. Then in the course of some time the thickness of the layer virtually does not change, but in the main stage when $\tau > 50$ increases proportionally to $\tau^{0.25}$. The entrainment rate decreases with an increase in time. The main density change occurs at the horizontal lower boundary of the layer. The process of fluid entrainment takes place due to interaction between turbulent eddies and the discontinuity. Short internal waves are emitted within the undisturbed fluid; their length is determined by the size of the generating eddies. Figures 6, tables 1; references 16: 8 Russian, 8 Western.
[268-5303]

SYSTEM FOR COLLECTION OF OCEANOLOGICAL DATA BY "PAYSIS" SUBMERSIBLE

Moscow OKEANOLOGIYA in Russian Vol 20, No 2, 1980 pp 345-349

[Article by A. M. Sagalevich, S. K. Dyukarev and Ye. S. Chernyayev, Institute of Oceanology, "System for Collection of Oceanological Data by the 'Paysis' Submersible and its First Use"]

[Abstract] On the 21st voyage of the "Dmitriy Mendeleyev" the first measurements were made using the data collection system carried aboard the "Paysis-7" submersible. The data collection system is illustrated in the text as a block diagram. The system consists of: a unit for the collection of data, installed in the vehicle together with a system of measuring sensors and a recorder; a data processing system, carried aboard the mother ship. The data collection unit makes it possible to carry out both multichannel transmission of analog and digital information from the measuring sensors and the videosignal from an underwater television camera and their registry with a videomagnetic recorder carried on the "Paysis" together with the data collection unit. This unit has 24 input channels: 16 analog and 8 digital. The analog channels have the following input parameters: voltage ±10 V, input resistance 100 megohm. The data collection unit also includes a 16-channel analog-code converter; the unit has a permanent memory for storing information on the sequence of interrogation of the input channels and a dynamic memory in which is formed a packet of data for its registry in the videosignal frame. Operation of the instrumentation is described with constant reference to the block diagram. The article also describes the programs used in mathematical processing of the collected information with an electronic computer. Figure 2 is a block diagram of the data processing program, serving as a basis for the discussion of its application. The article gives a brief analysis of the results obtained using the system. In this work the "Paysis" submerged uniformly at a mean rate of 10-12 m/min. The capability of the "Paysis" to hover in the water makes it possible to measure series of data at any of the horizons to 2,000 m, such as in studying the temporal variability of different parameters. Figures 3; references 2: 1 Russian, 1 Western.
[299-5303]

EFFECT OF ENERGY DISSIPATION FLUCTUATIONS ON TURBULENCE CHARACTERISTICS

Moscow OKEANOLOGIYA in Russian Vol 20, No 2, 1980 pp 230-234

[Article by V. S. Belyayev and M. M. Lyubimtsev, Institute of Oceanology, "Effect of Energy Dissipation Fluctuations on Turbulence Characteristics in the Ocean"]

[Abstract] The authors discuss the possible form of the laws of distribution of probabilities of the values of the conditional structural function in different scale intervals. The current structural functions of small-

scale fluctuations of current velocity are interpreted as evaluations of the conditional structural functions. The article gives the empirical distribution functions for the values of the logarithm of the current structural function for different shifts on the basis of measurements in towing and sounding regimes. It is shown that there is a possibility of the existence of an inertial interval in the investigated scale range. An evaluation of the universal constant of the refined theory of locally isotropic turbulence was obtained ($\mu = 0.50$). Special cases are considered. For example, if in the course of measurements the local background conditions vary in a quite broad range, in this case the distributions of the values of the current structural functions of current velocity fluctuations may evidently not correspond to a log-normal law. The difference in the form of the empirical functions of the distribution of probabilities of the current structural functions evidently is attributable to the fact that during sounding the background conditions determining the statistical regime of small-scale turbulence change appreciably with depth, whereas in the case of towing at a fixed horizon they can be considered quasiconstant. Figures 3; references 10: 7 Russian, 3 Western.
[299-5303]

MEASUREMENT OF FINE STRUCTURE OF HYDROPHYSICAL FIELDS AND TURBULENCE

Moscow OKEANOLOGIYA in Russian Vol 20, No 2, 1980 pp 235-241

[Article by R. V. Ozmidov, V. S. Belyayev, Yu. V. Nozdrin, A. M. Sagalevich, A. M. Podrazhanskiy and V. I. Fedonov, Institute of Oceanology, "Measurements of the Fine Structure of Hydrophysical Fields and Turbulence from 'Paysis' Submersible"]

[Abstract] The article presents the technical specifications for the manned "Paysis" submersible and the characteristics of the instrumentation carried aboard it for investigating the fine structure of hydrophysical fields and turbulence. The "Paysis" has a maximum submergence depth of 2,000 m. The crew can consist of two hydronauts and one observer. The vehicle weighs 10.5 tons and can operate independently for 216 man-hours. The craft has two engines operating from storage batteries and can develop a speed up to 2 knots. The ballast system makes it possible to change its buoyancy in a wide range, making it possible to regulate the rate of submergence and surfacing. The vehicle can hover at any horizon and its motion with engines at a given depth is at a constant speed. The instrumentation includes a set of hydrophysical sensors, television camera, underwater camera and videomagnetic recorder. This measuring complex constitutes an automated system for the collection of oceanological data. The sensors make it possible to measure temperature, conductivity, depth, speed of sound propagation in the water, percentage content of oxygen and rate of water movement relative to the vehicle. Each of the sensors is briefly described. Data are processed using a NR-9603 electronic computer aboard the "Dmitriy Mendeleyev." The results

of measurements in the Timor Sea are given. The peculiarities of the vertical microstructure of the conductivity field are explained as a possible manifestation of the effects of "fossil" turbulence and salt fingers. The flow at the bottom at a depth of 1,720 m during the time of measurements was close to laminar. It was found that use of such a submersible makes it possible to obtain important information on the microstructure of hydrophysical fields and local background conditions from the surface to a depth of 2,000 m, including in the immediate neighborhood of the bottom. Figures 5, tables 1; references 4: 2 Russian, 2 Western.
[299-5303]

USE OF SATELLITE RADIATION DATA FOR MAPPING OCEAN SURFACE TEMPERATURE

Moscow OKEANOLOGIYA in Russian Vol 20, No 2, 1980 pp 335-344

[Article by V. V. Vinogradov, Leningrad Division State Oceanographic Institute, "Use of Satellite Radiation Information for Plotting Maps of Ocean Surface Temperature"]

[Abstract] During 1974, under the GATE-74 program, over the area of experimental work in the Atlantic Ocean, in addition to two Soviet satellites of the "Meteor" system there were several American satellites, some of which operated in a direct transmission regime, enabling everyone to receive data, including in the IR range. Operating in the same area at this time were about 40 scientific research ships and a number of aircraft laboratories. In this article the author gives a comparison of satellite maps of radiation temperatures with synchronous shipboard observations. The data used were from the "Meteor-17" for the Pacific Ocean and the "NOAA-3" for the Atlantic Ocean. Figure 1 in the text is a map of water surface temperatures based on "Meteor-17" data; Fig. 2 is the corresponding map plotted on the basis of shipboard observations. The maps do not resemble each other very well, possibly due to an inadequate number of shipboard observations. Better information for study of thermal inhomogeneities at the water surface is provided by satellites in a direct transmission regime with exclusion of the influence of absorption by the atmosphere due to a tie-in of satellite measurements to shipboard observations in the IR range. Figure 3 in the text is an example of a map of radiation temperature of the water surface in the Atlantic Ocean obtained by a research ship during the 1974 tropical experiment. The map was plotted by computer processing of telemetric IR data from a NOAA satellite. This and other experiments have shown that a direct comparison of satellite radiation maps for the open ocean with shipboard observations is difficult for the following reasons: 1) point shipboard observations (or observations on short runs) cannot be compared with satellite data; 2) there are different physical principles involved in measuring surface temperature from a ship and satellite; 3) incorrectness of the model

of absorption by the atmosphere when computing radiation temperatures; 4) difficulty in accomplishing a precise coordinate tie-in of satellite data; 5) failure to take into account the diurnal variation of surface temperature, etc. The principal merit of satellite IR information is the possibility of routinely and in a large volume obtaining the radiation temperatures of the ocean surface directly on shipboard. With the organization of reception of IR information directly on a scientific research ship in ocean regions where cloud coverage is not greater than 5-7/10 it is possible to obtain maps of radiation temperatures with an error not greater than 1.5 K. Figures 4; references 13: 6 Russian, 7 Western.
[299-5303]

SPECTRAL CHARACTERISTICS OF WAVE MOVEMENTS IN RESERVOIR SURFACE LAYER

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3, FIZIKA, ASTRONOMIYA in Russian Vol 21, No 2, 1980 pp 68-73

[Article by V. V. Buklanov and A. A. Pivovarov, Moscow State University, "Spectral Characteristics of Wave Movements in Surface Layer of Reservoirs"]

[Abstract] The authors present the results of synchronous measurements of rise in the water surface and vertical and horizontal components of the velocity of water movement at two horizons under the conditions prevailing in a deep reservoir. The autospectra of the measured parameters, spectra of the square of coherence of rise of the water surface and the vertical component of orbital velocity and phase spectral relationships between the vertical and horizontal components of velocity of water movement are given. It was found that these results agree well with a model of separation of orbital movements in a wave into wave and turbulent parts. The rate of spectral decay of waves at frequencies above the spectral maximum corresponds to the Phillips law f^{-5}. The spectrum of the vertical component of velocity near the surface in the region of the principal energy-carrying wave frequencies has a regularity in the decay of the high-frequency part similar to the Phillips law, that is, the dynamics of the subsurface layer in this frequency region is determined by processes transpiring at its boundary. The more high-frequency part of the spectrum, which corresponds to the region of velocity fluctuations not coherent with the water surface rise, has a regularity of decay close to the law of locally isotropic turbulence. With increased depth the lower frequency boundary of this sector is displaced into the low-frequency region. The mean phase shift of the horizontal component relative to the vertical component differs from the theoretical value $\pi/2$ by some angle $\Delta\varphi$, as a result of which non-zero Reynolds stresses appear. Figures 3; references 7: 6 Russian, 1 Western.
[305-5303]

BEHAVIOR OF SOLUTION OF LINEAR EQUATIONS OF DYNAMICS OF BAROCLINIC OCEAN

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 16, No 3, 1980 pp 211-218

[Article by G. I. Marchuk and M. A. Bubnov, Computation Center Siberian Department USSR Academy of Sciences, "Asymptotic Behavior of Solution of Linear Equations of Dynamics of a Baroclinic Ocean Over Large Time Intervals"]

[Abstract] The stationary solution principle is now being used in solving many problems in oceanic dynamics. In solution of a nonstationary problem with a stationary or quasistationary right-hand side the initial perturbations attenuate and the solution arrives at a stationary regime. The authors here present a qualitative study and mathematical validation of this principle in linear problems of dynamics of a baroclinic ocean. The results presented here can be regarded as proof for the asymptotic stability of the state of equilibrium of a stably stratified fluid in the presence of dissipative factors. The rate of attenuation of the initial perturbations under the influence of these dissipative factors is estimated. The influence of boundary conditions on the attenuation rate is investigated. References 12: 11 Russian, 1 Western.
[268-5303]

RESTORATION OF SPECTRA OF SEA WAVES USING DATA FROM MOVING SENSORS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 16, No 3, 1980 pp 294-304

[Article by A. V. Kats and I. S. Spevak, Khar'kov State Scientific Research Institute of Metrology, "Restoration of Sea Wave Spectra from Measurements With Moving Sensors"]

[Abstract] In measurements of sea waves by a moving sensor the measured parameter, such as the surface rise, contains information both on the wave field itself and on motion of the sensor. The problem therefore arises of using data from such measurements for discriminating the statistical characteristics of sea waves, undistorted by motion of the sensor. Accordingly, the authors investigated the relationships of the frequency-angular wave spectra in uniformly moving and fixed reading systems. The conditions which make possible a restoration of the spectrum when it is not distorted by motion are given, particularly uniform linear motion for an arbitrary (two-dimensional) wave spectrum without restrictions on velocity. The results allow generalization for an arbitrary wave field. The authors examine limiting cases of a narrow angular wave spectrum and a low rate of movement of the sensors. A scheme for restoration of the true spectrum from measurements of level rise on several trajectories is proposed for these cases. Figures 4; references 7: 6 Russian, 1 Western.
[268-5303]

INTENSITY OF LIGHT BEAM REFLECTED FROM WAVE-COVERED SEA SURFACE

Moscow TRUDY TSENTRAL'NOY AEROLOGICHESKOY OBSERVATORII: ISSLEDOVANIYE ATMOSFERY I PODSTILAYUSHCHEY POVERKHNOSTI S ISPOL'ZOVANIYEM LAZERNOY TEKHNIKI in Russian Vol 138, 1979 pp 80-92

[Article by G. S. Gurevich, "Fluctuation of Intensity of a Light Beam Reflected from the Wave-Covered Sea Surface"]

[Abstract] The author examines the mean square intensity of monochromatic light reflected from the sea surface and the intensity fluctuation associated with it. There are basic differences between the problem to be solved and the problem examined by F. G. Bass and I. M. Fuks in the monograph RASSEYANIYE VOLN NA STATISTICHESKI NEROVNOY POVERKHNOSTI (Wave Scattering on a Statistically Uneven Surface), Moscow, "Nauka," 1972. These differences are related to the specific nature of lidar sounding and include representation of the incident wave in the form of a Gaussian beam, not a spherical wave, and allowance for the averaging effect of the receiver aperture. Accordingly, the objective of this investigation is a study of the dependence of fluctuation of the intensity of reflected light on two parameters: radius of the irradiated sector of the sea surface and the radius of the lidar receiving antenna. The author examines the reflection of a vertically incident monochromatic light beam from the sea surface; its divergence is considerably less than the fluctuation of the sea surface slopes. Light scattering in the atmosphere, in the water and foam is neglected. It is assumed that the irradiated surface sector is in the Fraunhofer zone relative to the source and the wavelength of light is small in comparison with the characteristic radii of curvature and the heights of irregularities of the reflecting surface. After formulating the problem in this way it is analyzed in great detail and solved. Expressions are derived, for example, which can be used in determining the second and fourth moments of the wave spectrum characterizing its high-frequency part, which, by virtue of the high sensitivity of this part of the spectrum to the presence of a petroleum film, suggests one of the possible ways to detect sea surface contamination by lidar techniques. References: 7 Russian.
[273-5303]

LIDAR DETERMINATION OF SEA SURFACE PARAMETERS

Moscow TRUDY TSENTRAL'NOY AEROLOGICHESKOY OBSERVATORII: ISSLEDOVANIYE ATMOSFERY I PODSTILAYUSHCHEY POVERKHNOSTI S ISPOL'ZOVANIYEM LAZERNOY TEKHNIKI in Russian Vol 138, 1979 pp 93-98

[Article by G. S. Gurevich, I. S. Zhigulova, B. M. Lysenko, V. I. Pavlov, V. Ye. Rokotyan and A. B. Sheynin, "Lidar Determination of Sea Surface Parameters"]

[Abstract] The use of lasers makes it possible to send a powerful short light pulse for considerable distances and sounding of the sea surface is possible with a universal lidar from a ship, from the shore or from an aircraft. Appropriate formulas are presented and it is demonstrated that the method makes it possible to obtain information on the form of the sea surface. Repeated sounding at the proper time interval yields data on the temporal evolution of the sea surface. For measuring the parameters of wind waves specialists have developed a universal lidar wave-measuring instrument. It can be used for making measurements from a ship, aircraft or from the shore. This outfit can operate in two regimes: a) radiation of individual pulses and b) radiation of pulses with repetition rates 1, 5, 12.5, 25, 50, 100 Hz. The radiation wavelength is 1.064 μm; pulse duration is 10 nanoseconds; accuracy of stabilization of the sounding angle is not worse than 1°. The instrumentation includes: 1. An optical-mechanical unit consisting of an IZ-4 source, receiver-transmitter, gyrovertical and scanning device. 2. Unit for supplying current to the lidar and its control. 3. Amplifier of pulsed signals. 4. Oscillograph. 5. Photorecorder. 6. Control panel. 7. Pulse generator. Figure 2 in the text is a functional diagram of the instrument. The structure and functioning of the instrumentation are briefly described. Programs for a "Minsk-32" computer were prepared for processing the results. This lidar wave-measuring instrument has been tested on shipboard, from an aircraft, and from a trestle over the water. Figures 2; references 2: 1 Russian, 1 Western.
[273-5303]

LIDAR AIRCRAFT STUDIES OF REFLECTIVITY CONTRASTS OF OIL-POLLUTED SEA

Moscow TRUDY TSENTRAL'NOY AEROLOGICHESKOY OBSERVATORII: ISSLEDOVANIYE ATMOSFERY I PODSTILAYUSHCHEY POVERKHNOSTI S ISPOL'ZOVANIYEM LAZERNOY TEKHNIKI in Russian Vol 138, 1979 pp 99-105

[Article by A. I. German, "Lidar Aircraft Investigations of Reflectivity Contrasts of a Sea Surface Contaminated by Petroleum"]

[Abstract] In 1975, during an expedition on the Caspian Sea for investigating noncontact methods for measuring the characteristics of the sea surface, an attempt was made to determine the applicability of lidar data

collected from an aircraft for determining contamination of the sea surface by petroleum under different wave conditions. The investigations were made using lidar apparatus carried aboard an Il-18 aircraft laboratory. The wavelength generated by the source was 0.53 and 1.06μm; beam divergence was 20 minutes of angle. Mean pulse power was (0.5...1.0) 10^6W at a wavelength 0.53μm and (1.0...3.0) 10^6W at 1.06μm. This outfit was used in measuring the sea surface reflection coefficients and depolarization of the reflected lidar pulse for different wave and contamination conditions. The instrumentation is inside the aircraft. The lidar radiation pulse is directed through a side aircraft window (of quarts glass) and by means of a special mirror outside is directed vertically downward. The radiation reflected by the water surface is directed through the same optical channel to the receiver objective. In the receiver the reflected pulse is converted into an electric pulse whose amplitude is proportional to the received pulse. When measuring polarization of the reflected radiation the reception is accomplished simultaneously by two receivers through polaroids mounted under them. The electric signal is photographed from an oscillograph screen. This is photographed by a special camera whose operation is synchronized with the lidar pulses. It was found that a lidar survey from an aircraft can be used for the registry of regions of petroleum contamination of the sea surface since its reflective properties have a sufficiently high correlation with the presence and even the thickness of a petroleum film. The depolarization of reflected lidar radiation at 0.53 and 1.06μm cannot reveal a dependence on petroleum contamination and without additional data on wave characteristics cannot serve as an indicator of a petroleum film on the sea surface. The use of a lidar for such purposes should only be used together with other remote sensing methods since lidar data under different wave conditions are inadequate for determining the quantity and quality of the petroleum surface film. Figures 2; references: 9 Russian.
[273-5303]

ACCURACY IN MEASURING SEA SURFACE PARAMETERS BY SCATTEROMETERS-ALTIMETERS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 16, No 3, 1980 pp 305-312

[Article by A. G. Luchinin, Institute of Applied Physics, "Accuracy in Measuring Sea Surface Parameters by Optical Scatterometers and Altimeters"]

[Abstract] The article examines the principal properties of signals in two types of active optical systems for observing the wave-covered sea surface -- scatterometers and altimeters. It is important to evaluate the accuracy with which it is possible to measure the dispersion of slopes or height when using these instruments and ascertain how this accuracy is related to the state of the surface and the principal instrument parameters. The accuracy of such measurements should be determined by the noise level of the

receiver and the intensity and spectral makeup of fluctuations of the signal entering the receiver. Since a method is known for calculating the photodetector noise, the article examines only the noise associated with fluctuations of the optical signal itself. The author therefore gives an evaluation for an ideal observation system in which the parameters of the received signal can be registered with as high an accuracy as desired. In this case the measurement accuracy will be characterized by the standard deviation of these parameters from their mean values, determined on the assumption of statistical uniformity of the surface. The article consists of three parts: 1. Functional relationships between sea surface parameters and sounding signals. 2. Energy spectrum of sounding signals. 3. Signal-to-noise ratio and limiting accuracy of measurements. Estimates are given of the accuracy of measurements of the dispersion of sea surface slopes and the distances between the mean level of the sea and the instrument. References 11: 7 Russian, 4 Western.
[268-5303]

TERRESTRIAL GEOPHYSICS

ALGORITHM FOR SOLUTION OF INVERSE PROBLEM IN GRAVIMETRIC-MAGNETIC SOUNDING

Sverdlovsk TEORIYA I PRAKTIKA PRIMENENIYA ANALITICHESKIKH METODOV INTERPRETATSII I MATEMATICHESKOGO MODELIROVANIYA GEOFIZICHESKIKH POLEY in Russian 1977 pp 22-30

[Article by F. I. Nikonova and A. V. Tsirul'skiy, "One Algorithm for an Approximate Solution of the Inverse Problem in Gravimetric and Magnetic Prospecting"]

[Abstract] In an earlier study (A. V. Tsirkul'skiy, "Solution of the Direct and Inverse Problem in Gravimetric Prospecting," IZV. AN SSSR, FIZIKA ZEMLI, No 7, 1974) one of the authors proposed an approximate method for solving the two-dimensional inverse problem in gravimetric and magnetic prospecting based on the automated fitting of the observed field to the real or fictitious part of a rational function of the complex variable u(z) with subsequent construction of equivalent families of solutions. Here $u(z) = -1/(V_x - iV_y)$; V_x, V_y are the derivatives of gravitational potential in the Cartesian coordinates x, y; $z = x + iy$; for brevity the u(z) function can be called the potential. The choice of an approximate construction was dictated by the fact that the class of potentials u(z) described by rational functions until recently was the only class for which it was possible to find an equivalent family of solutions. Here the authors describe a computation scheme and program for the method and also examine a number of problems arising in the development of the computation scheme. The interpretation of the observed potential field is broken down into the following principal stages. 1. The observed field is approximated by a function which is the real or fictitious part of a rational function of the complex variable. No other assumptions are made concerning the number of sources and their density. 2. It is assumed that the near-lying poles belong to the field of one homogeneous domain. An equivalent family is constructed for each of the groups of poles. Different variants of combining of poles into families can be tested. Each of these stages is discussed in detail. Figures 2, tables 1; references: 7 Russian.
[279-5303]

DETERMINATION OF HARMONIC MOMENTS OF DISTURBING BODIES

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 2, 1980 pp 103-110

[Article by A. V. Kudrya, Khar'kov State University, "Determination of Harmonic Moments of Disturbing Bodies from Gravitational Anomalies"]

[Abstract] A study of sources of gravitational anomalies on the basis of their harmonic moments began with the work of G. A. Gamburtsev. He derived formulas for determining the total anomalous mass and the coordinates of the center of gravity of isolated three-dimensional bodies. Later the mass-geometrical characteristics of the disturbing body were obtained in explicit form in the form of a sloping limited stratumlike body and the same characteristics for bodies of revolution. Considerable difficulties are now being encountered in practical use because the harmonic moments of the second and higher orders are determined extremely approximately and with different accuracy from gravitational anomalies. Accordingly, the author proposes a different method for determining the harmonic moments of three-dimensional bodies from gravitational anomalies. It is based on use of expansion of the potential field or its derivatives into a series in fundamental harmonic polynomials. It is shown that with the proper choice of observation points it is possible to make a reliable determination of the harmonic moments to the fourth order, as well as the constants of the linear regional background. Tables 2; references: 8 Russian.
[300-5303]

GRAVITATIONAL STRUCTURES IN THE EARTH'S CRUST

Dushanbe IZVESTIYA AKADEMII NAUK TADZHIKSKOY SSR, OTDELENIYE FIZIKO-MATEMATICHESKIKH I GEOLOGICHESKIKH NAUK in Russian No 4, 1979 pp 120-124

[Article by O. P. Sapov, Geology Institute Tadzhik Academy of Sciences, "Gravitational Structures in the Earth's Crust"]

[Abstract] After a discussion of landslide phenomena, the author discusses the very little studied problem of extrapolation of landslide phenomena into the deep parts of the earth's crust. It is clear that there is widespread occurrence of shearing displacements affecting the earth's crust down to the mantle. The name assigned to such structural forms is "circular blocks." The author proposes that this term be used to describe various deep analogues of landslide displacements. Circular blocks are a form of gravitational displacements of crustal masses complicating large uplifts and characteristic for the latest development stage. They are formed in the case of small slopes of averaged relief and constitute one of the forms of redistribution of stresses in the earth's crust, occupying an intermediate position between isostatic and surface forms of gravitational displacements. The

configuration of the circular blocks in vertical section is described by a cycloid. As in the case of landslides, circular blocks can form complicated forms. For example, in one of the variants complicating circular blocks are situated within first-order blocks. In a second variant they form a system imparting gravitational stresses over considerable distances. The scale of the described phenomena and their broad occurrence indicate that in complicating a folded structure they play a substantial role in the life of the earth's crust and must be taken into account in tectonic investigations. Figures 2; references: 4 Russian.
[275]

DESIGN OF AN n-CHANNEL SEISMOGRAPH

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 1, 1980 pp 125-137

[Article by A. V. Klyuchevskiy, Institute of the Earth's Crust Siberian Department USSR Academy of Sciences, "Design of an n-Channel Seismograph"]

[Abstract] The article describes the design of a new multichannel seismograph with galvanometric registry which makes it possible, when using ordinary seismometric instruments, to carry out simultaneous registry of different kinematic elements of motion of the ground at the necessary magnification levels. The use of such a multichannel seismograph makes it possible to lessen the influence of noise of a definite frequency, this being attained by both a decrease in response of the registry channel for these frequencies and the choice of a galvanometer with corresponding parameters. The method for computing the coupling coefficients is presented, followed by a discussion of the general form of the seismograph complex frequency characteristic and computation of the shunting resistances. The formula derived for the complex frequency characteristic was obtained taking into account all the mutual influences of the elements making up the system. The possibility for simple computations of the amplitude-frequency characteristic was investigated. A formula was derived for precise computation of the characteristic when the parameters of the galvanometers are identical. Three cases of computation of shunting resistances are proposed for ensuring the desired parameters of the seismograph. The proposed design reduces the number of seismic detectors required and increases the data yield and effectiveness of investigations. Figures 2; references 6: 5 Russian, 1 Western.
[274-5303]

METHODOLOGICAL PRINCIPLES AND METHODS FOR STUDYING WORLD OCEAN

Moscow GEOLOGIYA NEFTI I GAZA in Russian No 11, 1979 pp 1-6

[Article by B. F. D'yakov, All-Union Petroleum Scientific Research Institute for Geological Exploration, "Methodological Principles and Methods for Study of Geology and Petroleum and Gas Resources of the World Ocean"]

[Abstract] In order to have a point of departure for studying the geology and petroleum and gas resources of the world ocean researchers must apply sound methodological principles and methods. In this article the author defines the methodological principles and methods which he deems are most important and then evaluates them. For example, first it is necessary to adopt some concept of global tectonics (reference is to the old classical geotectonics, the tectonics of mobile lithospheric plates or other geotectonic concept of the earth's development). The researcher must resolve in his mind whether there is a fundamental difference between the continents and the world ocean. Is the geology of the world ocean, especially petroleum geology, an independent science? Equally important is the investigator's adoption of an organic, inorganic or mixed hypothesis concerning the origin of petroleum and hydrocarbon gases. A fundamental principle is involved in acceptance or rejection of the hypothesis that in nature there are tectonic-sedimentation elements of the earth's crust of different orders which constitute autonomous geological systems with their own sedimentogenesis, lithogenesis, tectogenesis, physicochemical conditions, fluid dynamics and sedimentary minerals, including petroleum and gas. The research must also decide whether to accept the thesis that the principal factor determining the presence of petroleum and gas both on the continents and in the world ocean is the quantity of sedimentary rocks in a particular region, in a particular sedimentary basin. Or is the principal factor determining the presence of petroleum and gas in a region the association of the latter with a particular type of sedimentary basin? The author gives a critical evaluation of each of these methodological questions and then presents a brief critique of the methods currently in use in studying the geology and presence of petroleum and gas in the world ocean. References: 7 Russian.
[265-5303]

SYSTEMS OF DEEP FAULTS IN THE NORTHEASTERN USSR

Moscow GEOTEKTONIKA in Russian No 2, 1980 pp 107-123

[Article by L. I. Sereda, Northeastern Territorial Geological Administration, "Systems of Deep Faults in the Northeastern USSR"]

[Abstract] A study was made of the principal indicators of deep faults. The ambiguity and complexity of their detection at a qualitative level of analysis of a complex of geological and geophysical data is discussed. The author feels that it is necessary to introduce quantitative research methods for discriminating zones of deep faults and a variant of an appropriate method is proposed. On the basis of a quantitative analysis of historical geology, geophysical and geomorphological materials for the territory of Magadanskaya Oblast it was possible to define zones of deep faults in isolines of the probability of presence of their indicators. The resulting linear zones with a length from a few hundred to a thousand or more kilometers and a width of several tens of kilometers in places are discontinuous, which is governed by the quantity of initial data used. The proposed method can be considerably improved in the future. Zones of deep faults in most cases bound large structural complexes; associated with these are epicenters of earthquakes of the energy class > 7, and also ultrabasic, basic and in part linear granitoid intrusions. The discriminated zones of deep faults form a cellular-block infrastructure of the earth's crust with different regimes of development of its blocks. The detected zones of deep faults are ore-concentrating for the principal types of minerals. Figures 5; references: 24 Russian.
[271]

DETECTION OF PETROLEUM AND GAS DEPOSITS BY HYDRODYNAMIC-GEOCHEMICAL METHODS

Moscow GEOLOGIYA NEFTI I GAZA in Russian No 1, 1980 pp 40-44

[Article by Yu. Z. Krupskiy, A. V. Saliy, I. R. Ban'kovskaya and N. I. Atamanyuk, Ivano-Frankovskiy Institute of Petroleum and Gas, "Detection of Petroleum and Gas Deposits by Hydrodynamic and Geochemical Methods in Ciscarpathia"]

[Abstract] The extent of geological study of the Ciscarpathian downwarp is so far advanced that traditional petroleum and gas reconnaissance and exploration work must be supplemented by new types of geological prospecting methods -- hydrodynamic and direct geochemical. Hydrodynamic investigations were begun in 1977 in the inner zone of the downwarp and in the Skibovaya zone of the Carpathians. Over fault zones there were clearly defined gas-microbiological, bituminological and other anomalies. It became clear that transverse dislocations in the downwarp conduct fluids. The hydrodynamic investigations demonstrated that in the inner zone there are

petroleum deposits hydrodynamically screened along faults (Fig. 1 in the text shows possible types of hydrodynamically screened traps of hydrocarbons in the inner zone). The effectiveness of this method was demonstrated in one case and several other cases of screened traps have been mapped and are recommended for drilling. If the results of these particular investigations are promising, the method will be regarded as a new direction in geological prospecting work for petroleum and gas in Ciscarpathia and the folded zones of the Carpathians. Figure 2 in the text shows the results of geochemical investigations in this area, including gas anomalies, microbiological anomalies and anomalies based on data from gasometry of the mud from seismic prospecting shot holes. This type of work has been carried out since 1975. Water samples were taken from wells and ground samples were taken from special geochemical boreholes. These geochemical investigations in the central part of the Ciscarpathian downwarp have made it possible to recommend that detailed large-scale seismic prospecting work be carried out in a number of anomalous zones with petroleum and gas indicators. Figures 2, tables 1; references: 9 Russian.
[266]

GEOLOGICAL PRINCIPLES FOR DETAILED SEISMIC REGIONALIZATION

Tashkent UZBEKSKIY GEOLOGICHESKIY ZHURNAL in Russian No 6, 1979 pp 55-60

[Article by V. I. Knauf, R. N. Ibragimov and A. M. Babayev, Seismology Institute, Uzbek Academy of Sciences, "Development of Geological Principles for Detailed Seismic Regionalization"]

[Abstract] Detailed seismic regionalization (DSR) involves determination of the totality of anticipated seismic effects in areas of occurrence of earthquakes and outside these areas where according to the general seismic regionalization map there can be tremors dangerous for existing and planned structures. DSR is carried out at scales of 1:1,000,000-1:200,000. The prepared maps are accompanied by an explanatory text. The choice of scale is dependent on the purpose of the DSR map. DSR maps at the various scales are necessary in choosing and planning new centers of population and industry, dams and transportation lines. Maps at 1:500,000-1:200,000 are intended for detecting anticipated seismic effects at construction sites of important projects. This paper outlines the methodological procedures used in compiling DSR maps, involving first the collection and integration of data on ancient structures and then recently formed structures. In the latter case the most important indices of recent movements (amplitudes, velocities, gradients) must be quantitatively determined, with particular attention to Holocene and recent movements. Geological and geomorphological investigations provide the basis for compiling an overall map of neotectonics, with emphasis on the characterization of faults as being the most probable seismic-generating structures. Geophysical data must be employed

wherever possible. The results of study of neotectonic structures are presented in the form of maps and a corresponding explanatory text. Seismic dislocations must be studied and classified. These dislocations must be dated if possible. Maps of tectonics of the basement, neotectonics, seismic dislocations, profiles and a map of earthquake epicenters are the initial data for compiling a seismotectonics map. The results of seismogeological investigations are used in compiling a DSR map on the basis of geological data (seismic danger map). The DSR map compiled on the basis of geological data and the corresponding map based on seismological data serve as a basis for creating an integrated, comprehensive DSR map. No figures, tables or references.
[233-5303]

USE OF TRANSVERSE WAVES METHOD IN AREA OF WATER-SATURATED SURFACE LAYERS

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 7, 1979 pp 75-88

[Article by G. V. Vedernikov, N. N. Kleshnin, G. V. Larkin, A. V. Trigubov and T. K. Firsova, Institute of Geology and Geophysics Siberian Department USSR Academy of Sciences and Siberian Geophysical Expedition USSR Petroleum Industry Expedition, "New Possibilities of the Transverse Waves Method Under the Conditions Prevailing on the West Siberian Plain"]

[Abstract] Experimental work which has been done on the development of a transverse waves method suitable for the conditions prevailing on the West Siberian Plain is reviewed. The principal factor which has impeded successful introduction of the method is the high position of the ground water, this resulting in a low effectiveness of the unvented borehole shot method. Several techniques were tested for overcoming this problem. The most effective of these was the trench source variant. A substantial (not less than an order of magnitude) increase in the "purity" of the excited field of transverse waves is ensured by this so-called "barrier" (trench) source; it involves use of two narrow slits (trenches) of a rectangular cross section, separated by a barrier of untouched ground. It is most applicable in winter when the charge can be placed in frozen ground. The conditions for using the method and the specific methods employed are described in detail. During winter it is now possible to obtain good wave patterns for all horizons of the sedimentary cover. The results are compared with the inferior wave patterns obtained using the common deep point method previously employed. Various suggestions are given on how to increase further the benefits which the trench or barrier method affords when work is done when the ground is frozen. Figures 10; references: 11 Russian.
[257-5303]

POLARIZATION PARAMETERS OF SEISMIC WAVES USED IN STUDY OF INHOMOGENEITIES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250, No 5, 1980 pp 1105-1108

[Article by A. G. Gamburtsev, S. I. Aleksandrov and V. V. Kuznetsov, Institute of Physics of the Earth, "Use of Seismic Wave Polarization Parameters in Study of Inhomogeneous Media"]

[Abstract] The instability of conditions for the excitation and reception of oscillations observed in seismic prospecting and active seismology considerably complicates the registered wave field and masks fine effects of the influence of random inhomogeneities. Therefore, it is desirable to broaden the range of studied parameters, specifically, the polarization parameters, characterizing the trajectories of displacement of particles: azimuth α, angle with the vertical β and $\eta = A_1/A_1 + A_2$ (A_1 and A_2 are the energy values along the principal axes of the polarization ellipse). In this paper it is demonstrated that the polarization parameters have a remarkable property: they are considerably less subject to the influence of the peculiarities of excitation conditions than such dynamic characteristics as amplitude and phase spectra. In a medium without clearly expressed inhomogeneities with a marked variability of the excited signals the polarization parameters retain a high stability. With passage of a wave through a medium containing inhomogeneous elements the polarization parameters and the wave ray will be dependent on fluctuations of the velocities of wave propagation in the inhomogeneous medium. The correlation radius of fluctuations of the polarization parameters will coincide with the correlation radius of amplitude fluctuations. Application of the method is illustrated in a specific example. Oscillations were excited in boreholes with a depth of 20 m, situated along an arcuate profile with its center at the mouth of a deep borehole. The distance between shot boreholes was 35 m. The polarization parameters are slightly dependent on excitation conditions. Experiments in which there was a simultaneous change in conditions for the excitation and reception of oscillations indicated that the latter exert little influence on the polarization characteristics of the waves. Variations in conditions of excitation and installation of instruments are one of the principal sources of distortions of the wave field and therefore a change to investigation of polarization characteristics should substantially increase the effectiveness of investigations of medium structure. Figures 3, tables 1; references: 5 Russian.
[238]

COMBINED USE OF AERIAL AND SPACE PHOTOS IN SEEKING LOCAL UPLIFTS

Moscow GEOLOGIYA NEFTI I GAZA in Russian No 11, 1979 pp 23-29

[Article by V. P. Mokiyenko, P. V. Medvedev and I. V. Oskolkov, Volgograd Scientific Research and Production Petroleum Institute, "Experience in Combined Use of Aerial and Space Photographic Surveys in Search for Local Uplifts"]

[Abstract] The literature contains little information on the combined use of aerial and space photographs in petroleum and gas exploration, especially for platform regions, although it is clear that aerial surveys are best in detecting local structures in the sedimentary cover and space surveys are best for solving problems in regional tectonics. The authors here give the results of such a combined study carried out in the northern part of the Dono-Medveditskiy mega-arch for the purpose of seeking local uplifts in the sedimentary cover. Earlier structural and geomorphological studies in the area revealed that local uplifts in the upper structural stage are clearly revealed at the surface by characteristic forms of relief and a combination of active geomorphological processes, such as strong development of erosional forms, radial pattern of the hydrographic network, increase in height of terraces, sharp narrowing of river valleys, etc. However, there have been no known indicators of local uplifts in the lower structural stage. The following effective program was adopted for such combined interpretation. 1. Neotectonic regionalization of the area, plotting of the principal dislocations and major morphologically well-expressed local uplifts from medium-scale space photos and their enlarged prints. 2. Geological and geomorphological interpretation of high-altitude aerial photographs, enlarged prints and photomaps. 3. Formulating a set of interpretation criteria for key local uplifts, neotectonic analysis of the geomorphological map and discrimination of landscape anomalies. 4. Interpretation of structural lines of possible local uplifts within the limits of landscape anomalies on small- and medium-scale air photos. 5. Preparation of a composite scheme for structural interpretation of materials from aerial and space photographic surveys. 6. Comparison of the results of interpretation with available geological and geophysical data (in each stage of the work). These are precisely the procedures used in studying the mentioned area. Seventy local uplifts were detected, 9 coinciding with known petroleum and gas deposits in the upper structural stage and 7 in the lower stage; 15 are presumably related to the upper stage, 24 to the lower stage; 15 are still under study. The results of this investigation are mapped in Fig. 1. Figures 2; references: 10 Russian.
[265-5303]

GRAVIMETRIC AND ELECTRIC EXPLORATION USED IN STUDYING SYSTEM OF DOWNWARPS

Moscow GEOLOGIYA NEFTI I GAZA in Russian No 11, 1979 pp 18-22

[Article by V. P. Stepanov and V. I. Bogatov, Tatar Petroleum Geophysics Trust, "Application of Gravimetric and Electric Exploration in Studying Geological Structure of Marginal Zones of the Kamsko-Kinel'skaya Downwarp System"]

[Abstract] The use of gravimetric and electric prospecting methods in the marginal zones of the Kamsko-Kinel'skaya downwarp system in Tataria and Kuybyshevskaya Oblast is discussed. For example, in this structurally complex area the terrigenous formations, primarily of the Malinovskiy subhorizon, are characterized by a zonal orientation and a thickness of 300-400 m. In electric exploration data they are characterized by maximum total longitudinal conductivity values. The results of electric exploration work are presented in the form of maps of conductivity and isopachs of terrigenous strata. These maps can then be used in defining sectors for seeking sedimentation structures and narrow erosional cuts in calcareous deposits. Detailed gravimetric exploration is used in tracing the marginal zones of the downwarps, where terrigenous rocks are replaced by calcareous rocks, and also defining their axial zones. On gravitational maps zones of reduced rock density are revealed by gravity minima. The marginal zones show up as gravitational steps. However, these gravitational steps, associated with marginal areas of downwarps, are not always reflected on gravitational maps because there is interference created by the composition of rocks of the crystalline basement, exerting a maximum effect when the basement is at a shallow depth (1.5-2 km). In order to trace the marginal zones of the system it is necessary to exclude the gravitational influence of basement rocks by a statistical (correlation) method. Corrections are also introduced into the initial field of gravity anomalies for the gravitational influence of density discontinuities. Data from a joint interpretation of gravity and magnetic anomalies are presented in the form of maps of the anomalous vertical gravity gradient, freed of the influence of anomalies or interference of the upper part of the section and the crystalline basement and in the form of structural maps of the surface of calcareous rocks filling the bottom of the downwarps. These methods and procedures were used in investigating the Aktanysh-Chishminskiy downwarp, the Nizhnekamskiy downwarp and the Mukhanovo-Yerokhovskiy downwarp. Specific results are given for these structures. Figures 3; references: 12 Russian.
[265-5303]

STUDY OF CRUST AND SUBCRUSTAL LAYER USING GRAVITY ANOMALIES

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 1, 1980 pp 108-116

[Article by P. I. Morsin, Siberian Scientific Research Institute of Geology, Geophysics and Study of Raw Materials, "Nature of Gravity Anomalies and Possibilities of Studying the Structure of the Earth's Crust and Subcrustal Layer on Their Basis"]

[Abstract] The formation of the total anomalous gravity field was studied on the basis of theoretical models of the lithosphere in hydrostatic equilibrium. These models were used in analyzing the structure of some characteristic practical models -- crustal sections obtained by the deep sounding method. It is shown that the possibilities of detecting anomalous density in layers situated close to the Mohorovicic discontinuity on the basis of the gravitational field are quite limited. Without deep seismic sounding data it is impossible to make an unambiguous determination of the lithospheric layers in which there may be a density deviation from the density assumed in a normal model. It is essential that such a determination be made if the anomalous densities are in layers situated above and below the Mohorovicic discontinuity, since the interpretation of the gravity field without allowance for such peculiarities of lithospheric structure can lead not only to quantitative errors, but also to erroneous geological conclusions. It is made clear that the structuring of a model of the lithosphere on the basis of an interpretation of gravity anomalies is multivariant; the latter can be considerably limited by having a rationally laid-out deep seismic sounding network. Recommendations are given on the optimum distances between deep seismic sounding profiles. When laying out the network it is necessary to take into account the lateral dimensions of blocks which are in hydrostatic equilibrium, and accordingly the optimum distance between reference deep sections of the lithosphere should be 100-150 km. Figures 4, tables 3; references: 15 Russian.
[274-5303]

EVALUATION OF POSSIBILITIES OF HYDROCARBONS IN PART OF CASPIAN SYNECLISE

Moscow NEFTEGAZOVAYA GEOLOGIYA I GEOFIZIKA in Russian No 1, 1980 pp 21-25

[Article by N. V. Grekova and N. I. Uskova, Lower Volga Scientific Research Institute of Geology and Geophysics, "Tectonic Criteria for Evaluating the Presence of Petroleum and Gas in Local Structural Traps on the Northwestern Margin of the Caspian Syneclise"]

[Abstract] Many years of petroleum and gas exploration work on the northwestern margin of the Caspian syneclise have indicated that a highly important factor in such search is a clarification of the patterns of distribution of local uplifts controlling the distribution of most of the detected

productive petroleum and gas deposits. In predicting the presence of petroleum and gas in local structures it is desirable to use the comparative geological method, based on a knowledge of the morphology and genesis of these local structures, their genetic relationship to dislocations and the nature of neotectonic movements. A structural trap is the object of local prediction. In the Lower Volga area most local structures are associated with flexures corresponding to dislocations. Researchers in this area have mapped deep faults and more shallow dislocations and have defined five types of faults and dislocations. It has been found that in predicting the presence of hydrocarbons the greatest attention should be given to structures associated with disjunctive dislocations of the "through" type, especially those recently activated. In the investigated area the most common structures are those of the buried and inversion types. On the northwestern margin of the Caspian syneclise, over an extent of more than 1,000 km from Volgograd to Orenburg, there are a number of petroleum and gas deposits directly associated with marginal faults. Most of the productive structures are in zones along faults. Data were obtained making it possible to analyze the influence of different types of dislocations on the formation of zones of petroleum and gas accumulation. It seems clear that the local structures most favorable for petroleum and gas are those associated with "through" dislocations of types I and III (defined in the text). A neotectonic analysis suggests that recent movements exerted a considerable influence on the formation and distribution of petroleum and gas deposits. Thus, neotectonic conditions must be studied in order to evaluate the possibilities of finding hydrocarbons. Figures 2; references: 11 Russian.
[293-5303]

TECTONICS OF SUBSALT DEPOSITS IN SOUTH EMBA REGION

Moscow NEFTEGAZOVAYA GEOLOGIYA I GEOFIZIKA in Russian No 1, 1980 pp 25-29

[Article by Ya. Sh. Shafiro, Volgograd Scientific Research and Production Petroleum Institute, "Tectonics of Subsalt Deposits of the Coastal Part of the South Emba Petroleum and Gas Region"]

[Abstract] The subsalt deposits of the western part of the South Emba region have been explored during recent years and it has been discovered that there are considerable possibilities of detecting petroleum and gas in the subsalt Paleozoic. Specific finds of hydrocarbons in this region are discussed, with details concerning the strata and structures with which they are associated. In the coastal sector of the Lower Emba region, in a meridional zone with an extent of 100 km and a width of 30 km, specialists have mapped a system of high-amplitude uplifts (see map, Fig. 1) along the seismic horizons of the subsalt Paleozoic, and it is these uplifts to which the author devotes his main attention in this article. Deep exploratory drilling in the northern sector of dislocations in this region is complicated by anomalously

high stratum pressures (AHSP) and considerable sulfur dioxide concentrations in the subsalt deposits. AHSP in the subsalt complex of the inner part of the Caspian depression is caused by the presence of a thick salt cap. In the southeastern marginal zone of the Caspian depression the Kungurskaya halogen stratum is wedged out and pre-Triassic erosion has been almost completely annihilated on the arches of the uplifts. It can therefore be postulated that the stratum pressures and sulfur dioxide concentrations in the subsalt deposits here will be considerably lower than in the northern regions. The structures of the southern part of the coastal area of dislocations evidently are the most promising with respect to the possibilities for finding petroleum and gas. Figures 3; references: 9 Russian.
[293-5303]

NEW METHOD FOR PREPARING GROUND FOR EXCITATION OF TRANSVERSE WAVES

Moscow NEFTEGAZOVAYA GEOLOGIYA I GEOFIZIKA in Russian No 1, 1980 pp 29-32

[Article by L. I. Ivanov, G. V. Vedernikov and A. V. Trigubov, USSR Petroleum Industry Ministry and Siberian Geophysical Expedition, "Excitation of Transverse Waves Using DSh Plow-Type Embedders"]

[Abstract] Various methods have been employed in preparing the ground for embedding shots for the excitation of transverse waves. These methods have proved to be inadequate in various ways, or costly (for example, the digging of trenches is very time consuming). The Siberian Geophysical Expedition was assigned the task of developing a more effective, less time-consuming technique for preparing the ground for the embedding of the explosive charges used in exciting transverse waves. The solution described here is a plow- or blade- type of explosive embedder. It was necessary to study the characteristics of ground destruction with different designs of blades in two- and three-blade variants. It was found that in most cases there is a total destruction (pulverization) of the ground in the space between the blades. The resulting nonuniformity of the ground is close to that in a traditionally used trench which has been refilled with unconsolidated absorbing ground. The best configuration of the blades is one which makes the loosened ground zone as close as possible to a trench with vertical walls. All pertinent parameters were investigated, such as the distance between blades, number of blades, etc. It was found, in general, that the explosive should be embedded at a depth of 35-40 cm and the distance between the blades should be 40-50 cm. The method appears to be reliable under a variety of seismogeological conditions, ensuring the tracing of reflecting discontinuities to a depth of 2-3 km. The magnitude of the explosive charge is discussed. Figures 4; references: 5 Russian.
[293-5303]

PHYSICS OF ATMOSPHERE

DETERMINATION OF PARAMETERS OF SMOKE AEROSOLS FROM POLARIZATION MEASUREMENTS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 3, 1980 pp 270-276

[Article by V. V. Veretennikov, V. S. Kozlov, I. E. Naats and V. Ya. Fadeyev, Institute of Atmospheric Optics, Siberian Department USSR Academy of Sciences, "Determination of Optical Constants and Microstructure of Smoke Aerosols from Optical Polarization Measurements"]

[Abstract] The authors made investigations for determining the microstructure of the refractive index of smoke by the methods of inversion of optical polarization measurements (inverse problems method). Emphasis was not only on determining the refractive index and microstructure of the aerosol, but also on studying their dependence on relative humidity. Such information is necessary in the laser sounding of smoke and remote determination of microstructure of disperse air pollutants. The initial data used were measurements of the polarized scattering indicatrices for a wood smoke aerosol at a wavelength 0.63μm using a nephelometer. It was found that relative humidity plays an important role in the transformation of the optical and microphysical properties of a smoke aerosol. Evaluations of the microstructure and refractive index of smoke particles revealed a quite high effectiveness of use of the inverse problems method for studying the physical processes transpiring in aerosol media. Optical methods, in combination with highly effective algorithms for the numerical inversion of polarization measurements, are an important tool in monitoring the structure of aerosols. Figures 3; references 20: 16 Russian, 4 Western.
[268-5303]

IMAGE QUALITY FOR RADIATION SCATTERED BY A TURBULENT MEDIUM

Moscow TRUDY TSENTRAL'NOY AEROLOGICHESKOY OBSERVATORII: ISSLEDOVANIYE ATMOSFERY I PODSTILAYUSHCHEY POVERKHNOSTI S ISPOL'ZOVANIYEM LAZERNOY TEKHNIKI in Russian Vol 138, 1979 pp 23-26

[Article by Ye. M. Birger, G. M. Kruchenitskiy and V. Ye. Rokotyan, "Evaluation of Quality of Images Obtained in Radiation Scattered by a Turbulent Medium"]

[Abstract] Investigation of the characteristics of turbulent flows is of interest for aerology, aerodynamics, laser sounding, communication and a number of other branches of technology. Remote methods for studying such flows are of particular interest. This includes the lidar, Doppler and holographic methods. Unfortunately, the latter two methods are inconvenient for use in the field. Therefore, the authors here report on an attempt to study the properties of a turbulent flow by means of spatial heterodyning of laser radiation passing through this flow. In this investigation the heterodyning principle involved the following. The sounding radiation, after passage through the medium to be investigated, has a two-dimensional spatial spectrum $F(\omega)$, carrying information on the spatial inhomogeneities of the medium. Laboratory experiments were carried out in which a turbulent flow was created by a fan. The mean velocities on the beam axis were varied from 0.4 to 4 m/sec. The radiation source was an LG-75 helium-neon laser with an output power of 2.3 mW. Beam divergence at the telescope exit was 30'; the beam diameter was 5 cm. Registry of the filter image was with a "Zenit-V" camera. The transverse dimension of the filter was 1 cm. The negatives were measured photometrically using a MF-4 microphotometer. The results of these photometric measurements are given in Table 1. The results indicate that the spatial heterodyning method is quite sensitive and can be used for investigating the spatial structure of turbulent flows. Figures 2, tables 1; references 3: 2 Russian, 1 Western.
[273-5303]

SIGNAL FREQUENCY SPECTRUM IN RADIOACOUSTIC SOUNDING

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 3, 1980 pp 219-228

[Article by A. I. Kon and V. I. Tatarskiy, Institute of Atmospheric Physics, "Frequency Spectrum of Scattered Signal in Radioacoustic Atmospheric Sounding"]

[Abstract] The problem of the frequency spectrum of a scattered radio signal in radioacoustic sounding of the atmosphere is examined in detail. An expression is derived and analyzed for the scattered field in a general case when the durations of both the acoustic and radio signals are finite. It is shown that in the case of a small spatial duration of the radio signal the frequency shift of the received signal can differ very greatly from the Doppler shift corresponding to the carrier frequency. In practical radioacoustic sounding systems it is customary to use periodically repeating rather than individual pulses. Since the frequency spectrum of such a periodic series of pulses is determined unambiguously by the frequency spectrum of an individual pulse and the repetition rate, no additional information is required for this case. The spectrum of a periodic signal differs from the spectrum of an individual pulse in that it is the totality of discrete lines, separated from one another by the repetition rate, whose envelope is the spectrum of a single pulse. References 12: 10 Russian, 2 Western.
[268-5303]

ACCURACY OF LIDAR MEASUREMENTS OF OZONE

Moscow TRUDY TSENTRAL'NOY AEROLOGICHESKOY OBSERVATORII: ISSLEDOVANIYE ATMOSFERY I PODSTILAYUSHCHEY POVERKHNOSTI S ISPOL'ZOVANIYEM LAZERNOY TEKHNIKI in Russian Vol 138, 1979 pp 27-31

[Article by N. D. Smirnov, "Accuracy of Lidar Measurements of Ozone Density in the Troposphere and Stratosphere"]

[Abstract] The author discusses a number of methodological problems related to lidar sounding of the troposphere and stratosphere in the UV spectral region. Measurements of tropospheric ozone density (especially in the surface layer) are complicated by the fact that the components responsible for absorption in the UV spectral region (NO_2, SO_2 and others) can be present in quantities considerably exceeding the ozone content and to a considerable degree determine the value of the absorption coefficient and the correction C, related to molecular and aerosol scattering, due to the great variability of the latter, cannot be correctly taken into account. Under such conditions it is impossible to measure ozone density at two wavelengths and therefore it is necessary to use the method of comparative absorption with sounding at multiple wavelengths. If it is assumed that a gas mixture contains K components with overlapping spectra and it is necessary to measure the correction C (that is, actually determine k + 1 components), in a limited interval of wavelengths $\Delta\lambda \ll \lambda$ it is necessary to select k + 2 fixed wavelengths — λ_n and for each of k + 1 intervals $\Delta\lambda_n = \lambda_{n+1} - \lambda_n$ it is necessary to write equations taking into account the property of additivity of the absorption coefficients. Then a system of k + 1 equations is written for determining the density of each of the k components. In measurements in the real atmosphere it is necessary to take into account all the components having comparable absorption coefficients in some spectral region. If the objective is to measure O_3 density with an accuracy not worse than 10% under any conditions, it is necessary to measure the interfering components and the correction with an accuracy not worse than 1%, which requires use of the comparative absorption method with sounding at five frequencies. In this way it is possible to determine the density of all three absorbing components O_3, SO_2 and NO_2. It is shown that the mean accuracy of lidar measurements can be evaluated with a high reliability when a sufficiently large volume of data is available. Figures 1; references 6: 4 Russian, 2 Western.
[273-5303]

EFFECT OF AEROSOL ON STRUCTURAL FUNCTION OF REFRACTIVE INDEX

Moscow TRUDY TSENTRAL'NOY AEROLOGICHESKOY OBSERVATORII: ISSLEDOVANIYE ATMOSFERY I PODSTILAYUSHCHEY POVERKHNOSTI S ISPOL'ZOVANIYEM LAZERNOY TEKHNIKI in Russian Vol 138, 1979 pp 3-10

[Article by V. N. Gorelkin, V. V. Dodonov, L. P. Kotova, I. A. Malkin, V. M. Zakharov, G. M. Kruchenitskiy and V. Ye. Rokotyan, "Effect of Aerosol on the Structural Function of the Refractive Index for a Turbulent Medium"]

[Abstract] Turbulent fluctuations of the refractive index and fluctuations of the light waves caused by them exert a significant influence on the operation of sounding, communication and navigation systems using laser radiation. In order to take this influence into account it is necessary to know the structural function of the refractive index. However, in all estimates used in both theoretical and experimental studies the influence which the discrete scatterers of an aerosol nature exert on the statistical properties of the refractive index field is neglected. The authors have therefore developed a method for taking this influence into account and evaluating the contribution made by discrete scatterers to the structural function of the refractive index. The parameters of the scattering problem were selected in accordance with traditional concepts concerning the particle size and concentration of aerosol in the real atmosphere. It is shown that allowance for the correlation of motion of an aerosol and the turbulent medium in some cases can lead to a substantial dependence of the constants in the structural functions of the dielectric constant on the aerosol parameters. References 10: 9 Russian, 1 Western.
[273-5303]

SPACE LIDAR DETERMINATIONS OF AEROSOL VARIATIONS

Moscow TRUDY TSENTRAL'NOY AEROLOGICHESKOY OBSERVATORII: ISSLEDOVANIYE ATMOSFERY I PODSTILAYUSHCHEY POVERKHNOSTI S ISPOL'ZOVANIYEM LAZERNOY TEKHNIKI in Russian Vol 138, 1979 pp 11-15

[Article by L. N. Birich, A. I. German, O. K. Kostko and V. Ye. Mel'nikov, "Determination of Spatial-Temporal Aerosol Variations in the Atmosphere by Lidar Apparatus from Space Vehicles"]

[Abstract] Lidar sounding of the atmosphere from satellites will make it possible to investigate the dynamics of aerosol layers and the aerosol background over extensive areas of the land and oceans. Apparatus with physicotechnical parameters ensuring reliable registry of the aerosol scattering signal can be created using a laser and the optical receiving system of an on-board submillimeter telescope. As the high-response photodetector of a lidar based on a ruby laser it is possible to use a photomultiplier whose

great sensitivity makes it possible to register the aerosol scattering signal in a photon-counting regime. Assuming that the maximum admissible parameters of the on-board lidar are a pulse power E = 1 J and an area of the receiving antenna S_a = 1 m^2, for a layered-homogeneous atmospheric model in a single scattering approximation it is possible to estimate the scattered radiation from an aerosol layer with a particular thickness for a particular distance. The calculations presented here show that in measurements in the altitude range from 35 to 80 km with an error of 40% it is necessary to make from 2 to 100 soundings. Due to the great velocity of space vehicles relative to the earth, in an investigation of local sources of aerosol particles the maximum grid interval used in the measurements must not exceed 1 km and the minimum lidar pulse repetition rate must be 10 Hz in measurements to altitudes of 20 km and 100 Hz to altitudes 70 km. A satellite lidar ensuring determination of the spatial-temporal variations of aerosol with an error of 30-40% to altitudes 70 km from the earth's surface can be realized on the basis of presently existing lidars and on-board optical systems. The principal shortcomings of the proposed lidar are its relatively great weight (up to 300 kg) and required current supply (up to 20 KW), which considerably restricts the possibilities of its placement aboard space vehicles. Figures 1; references 10: 9 Russian, 1 Western.
[273-5303]

ARCTIC AND ANTARCTIC RESEARCH

WEAK LARGE-SCALE INHOMOGENEITIES IN AURORAL IONOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian No 2, 1980 pp 271-274

[Article by M. G. Gel'berg, Polar Geophysical Institute, Kola Affiliate USSR Academy of Sciences, and Institute of Space Physics Research and Aeronomy Yakutsk Affiliate Siberian Department USSR Academy of Sciences, "Formation of Weak Large-Scale Inhomogeneities in the Auroral Ionosphere"]

[Abstract] A study was made of interaction between the auroral ionosphere and infrasonic waves propagating at small angles to the horizontal. It is demonstrated that at the altitudes of the F region, in the presence of an external electric field E_0, infrasonic waves cause the appearance of a periodic polarization field which produces a redistribution of charges. The amplitude of the moving disturbances is proportional to E_0, the amplitude of the infrasonic wave, and is dependent on the orientation of the wave vector k relative to E_0 and B_0. A possible reason for the appearance of infrasonic waves in the auroral ionosphere is their generation at altitudes 100-120 km by pulsating auroral arcs. If the ϑ angle between the external electric field E_0 and the horizontal component of the wave vector k satisfies the spatial resonance condition $\vartheta = \arcsin(v_{ph}/u_d)$ (v_{ph} is the phase velocity of the wave, u_d is the velocity of plasma drift), the amplitude of the disturbance of electron concentration will exceed the amplitude of the infrasonic wave. References 9: 5 Russian, 4 Western. [303-5303]

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